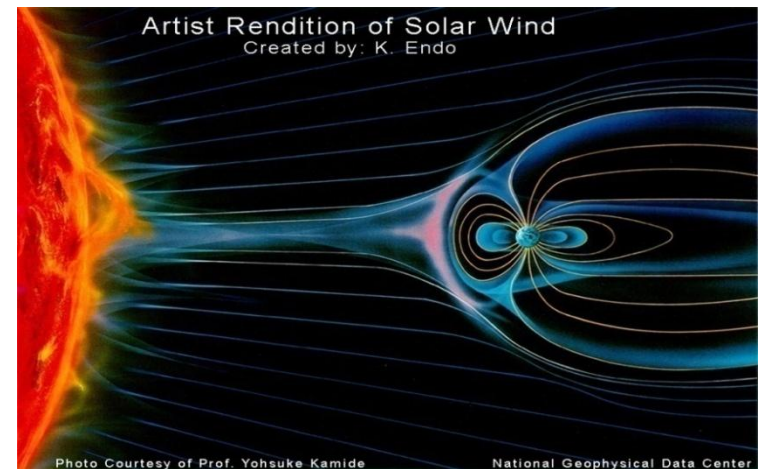




*To protect space assets from high energy particles by developing
European dynamic modelling and forecasting capabilities*

www.fp7-spacecast.eu

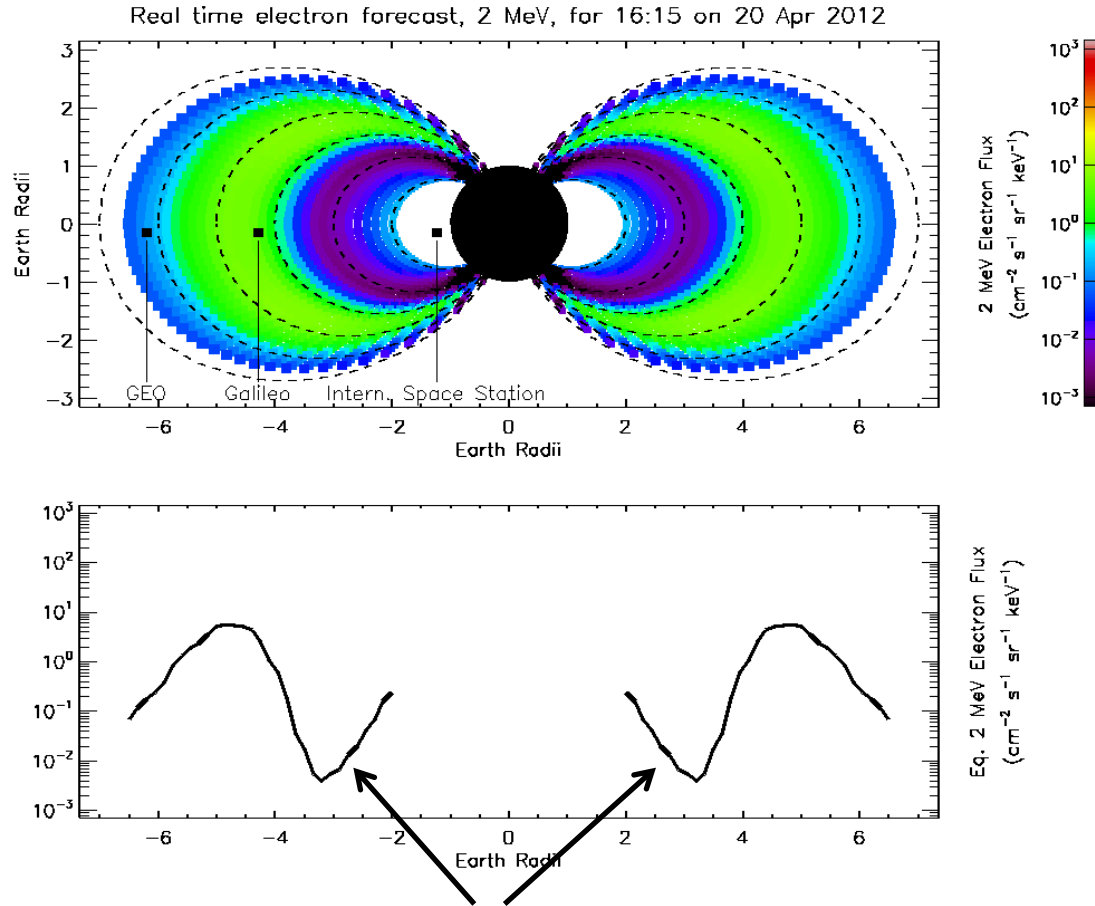
- New 3 year FP7 collaborative project
- Focus on high energy charged particles
- 7 European partners
- 4 US partners



SPACECAST – Forecast the whole Rad Belt

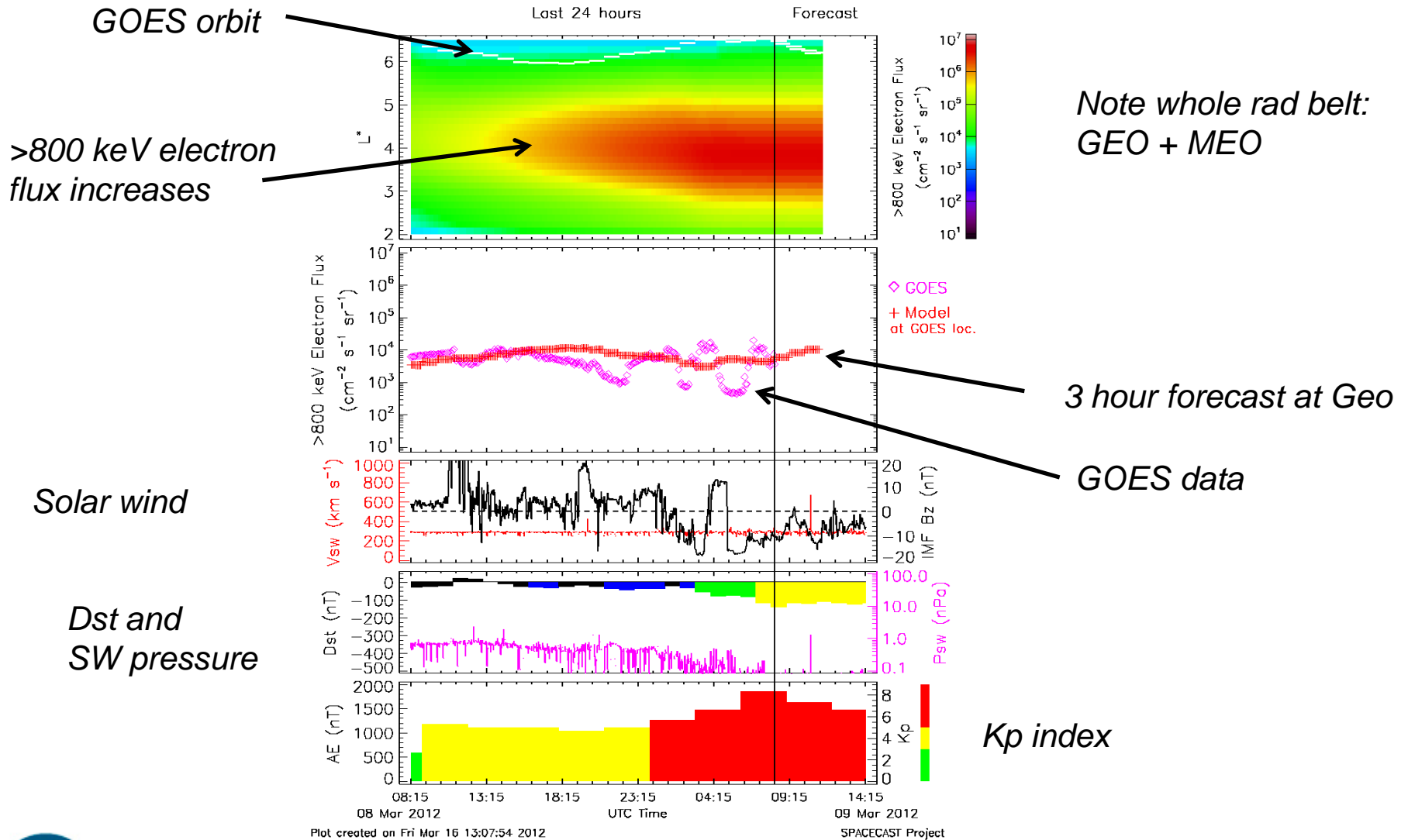
- Collect real time data from ACE and GOES, the British Geological Survey, and a forecast of Kp from Lund, Sweden
- Data combined with a database at DHC in Belgium
- Distributed to modelling centres in Cambridge UK, Toulouse, France
- Models run every hour and forecast electron flux 3 hours ahead, a 24 hr electron fluence, and a risk index for internal charging
- Results displayed via web site hosted in Belgium, updated every hour
- Fully automated, available since March 2012

SPACECAST – Forecast the whole RB



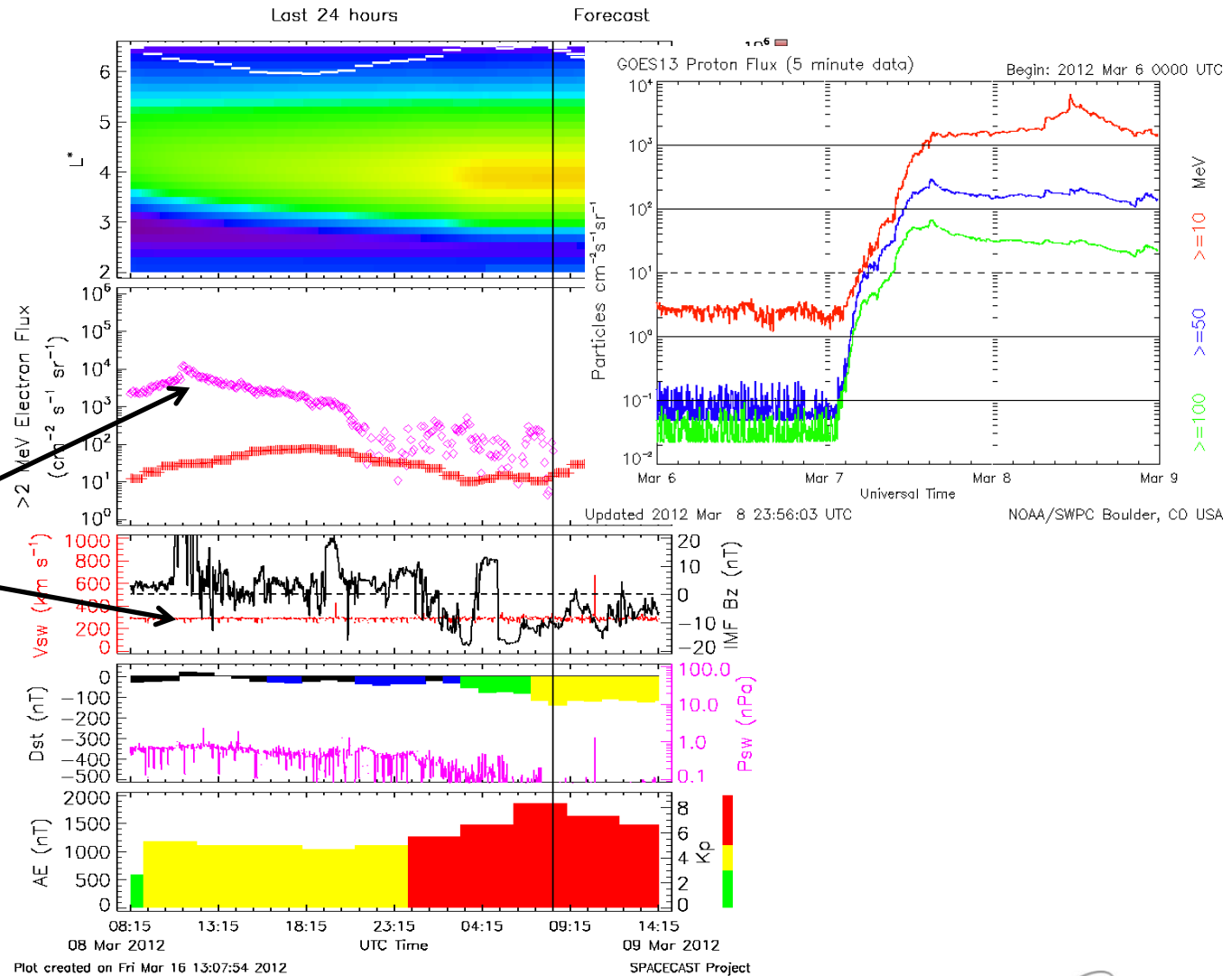
Losses due to wave-particle interactions – form the slot region

SPACECAST – Forecast >800 keV electrons



SPACECAST > 2 MeV Electrons

Satellite data
affected by SW

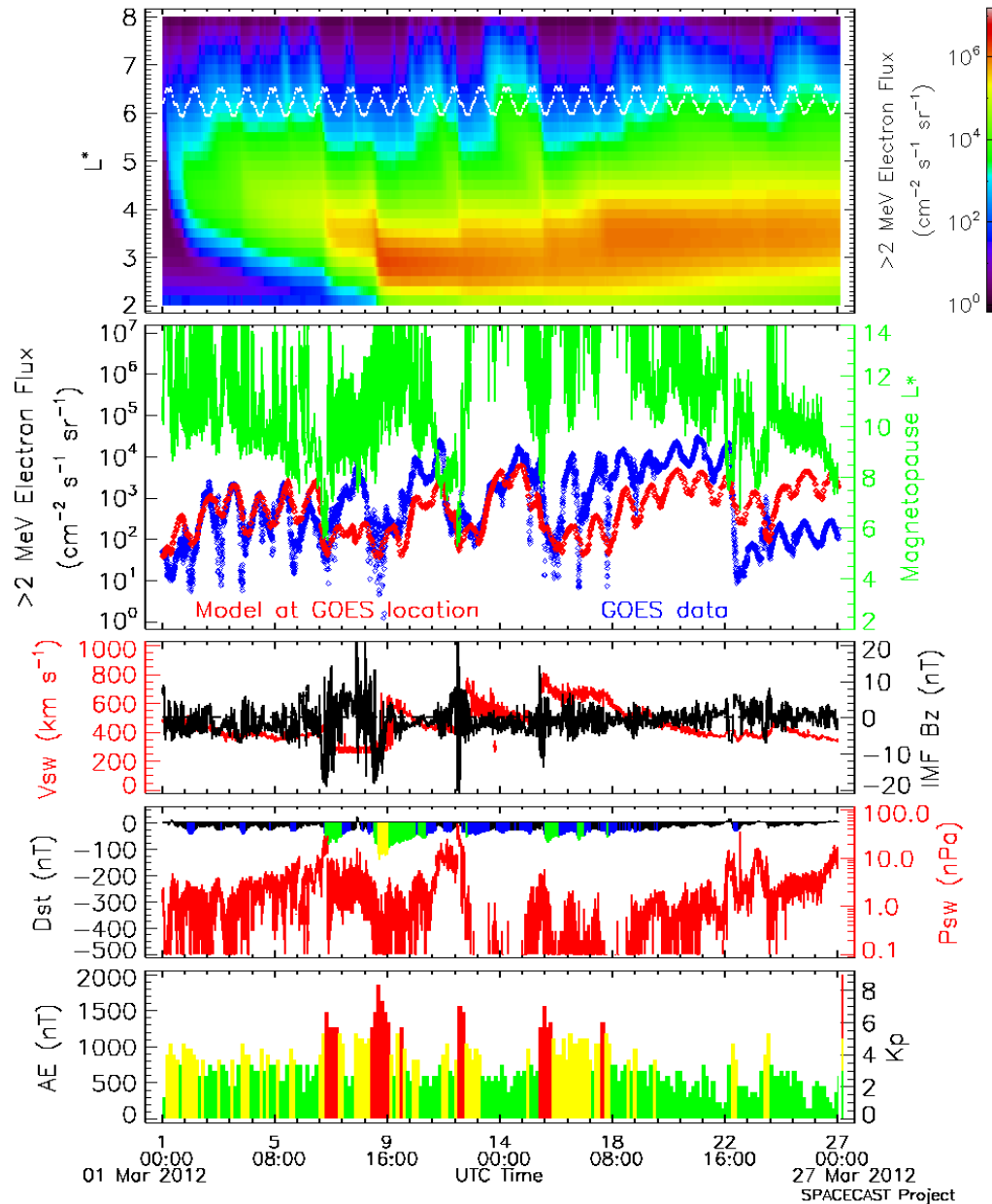


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March 2012



Forecast in red
data in blue

Uses

Physics based model - we can:

- Predict what is likely to happen in the next few hours
- Results for orbits where there are no data
- Calculate average and extreme conditions
- Reconstruct what happened in the past – for satellite anomalies
- Calculate particles precipitating into the atmosphere



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Conclusions

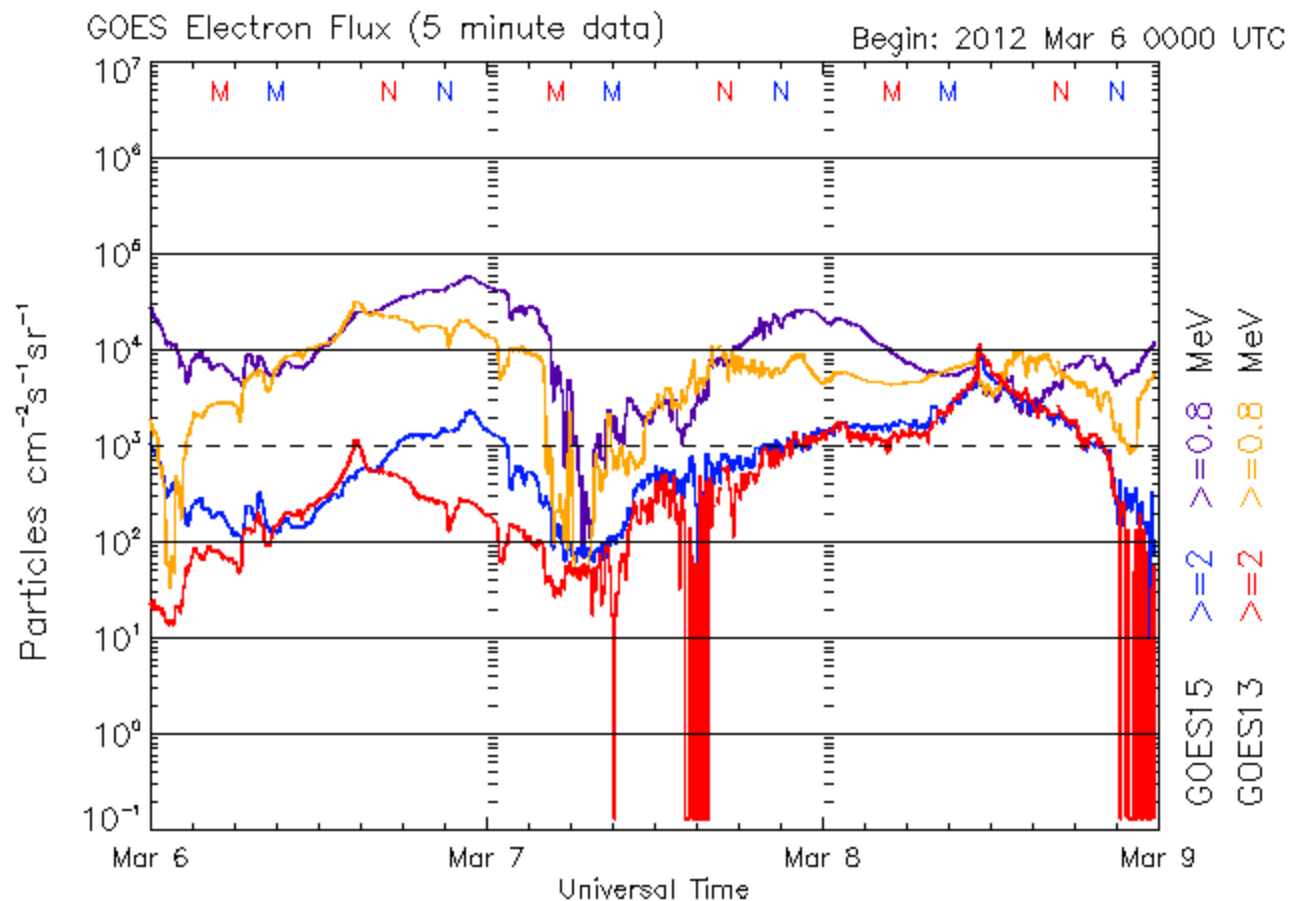
- SPACECAST makes real time forecasts of the radiation belts for satellite operators
- Will issue warnings and alerts to stakeholders
- Models solar energetic particle events to help develop forecasts
- Pre-operational, freely available
- Would like feedback on what information you need, displays, thresholds...
- The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement no 262468



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Flux drop outs

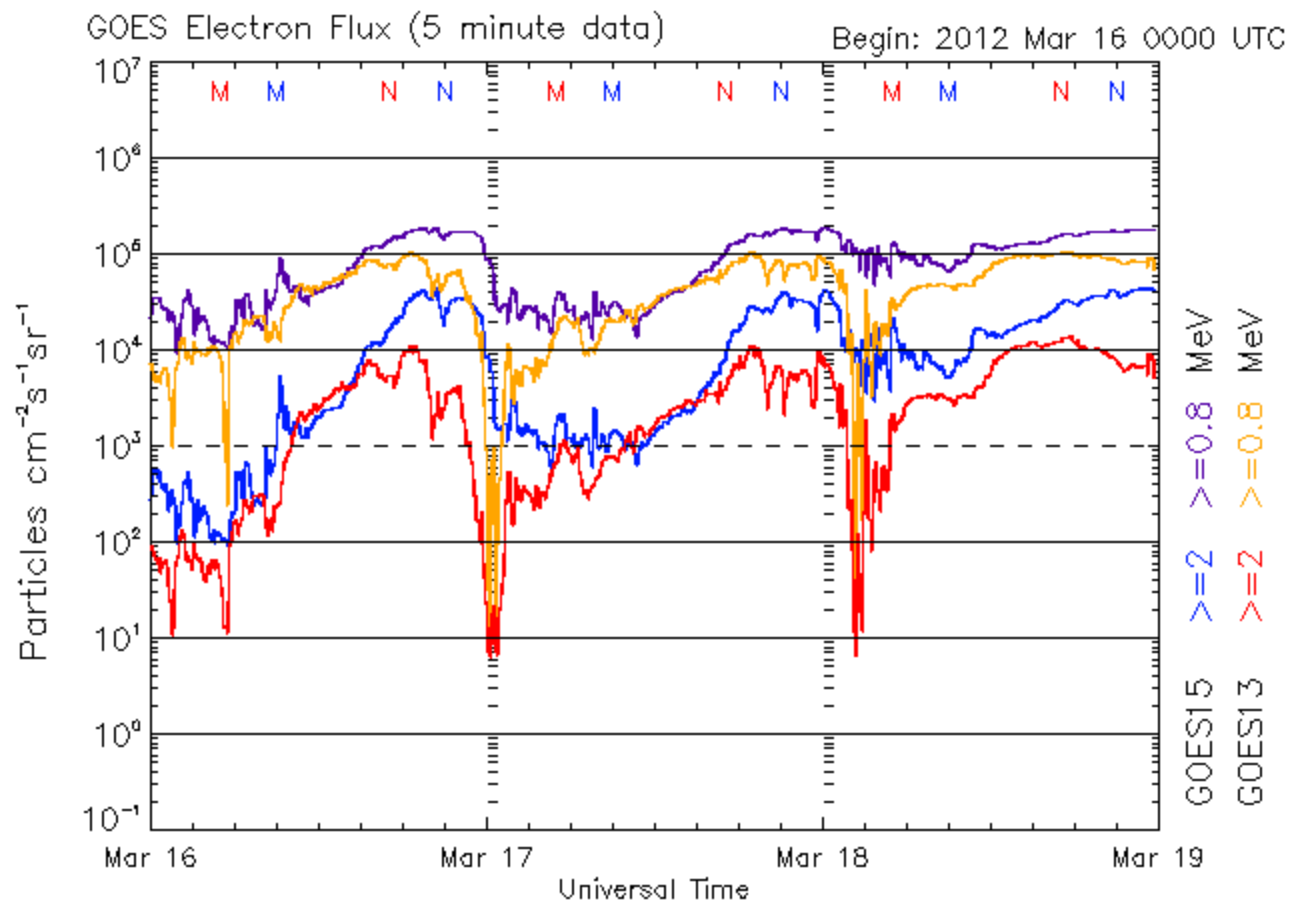


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Flux drop outs



Updated 2012 Mar 18 23:56:04 UTC

NOAA/SWPC Boulder, CO USA



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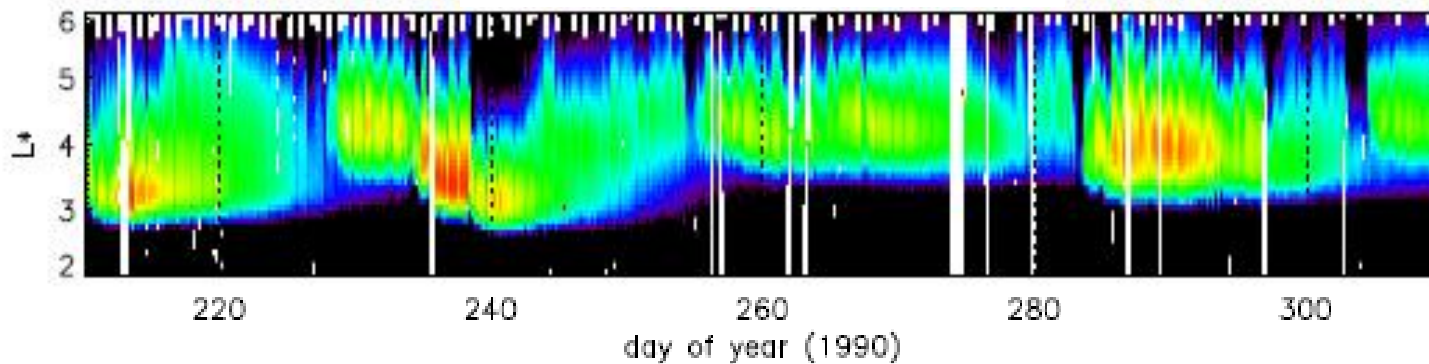


Satellite Anomalies – When SW Conditions Disturbed

- 20th Jan 1994 Intelsat 4, Anik E1 and Anik E2
 - Intelsat 4 and Anik E1 were recovered in a few hours
 - Anik E2 - **Loss of service for 6 months**
- 11th January 1997
 - Telstar 401 - **Total loss** – Insurance payout \$132m
- 19th May 1998
 - Galaxy IV - **Total loss** – Insurance payout \$165m
- 23rd Oct to 6th Nov 2003
 - 47 satellites reported malfunctions
 - Midori 2 - **Total loss** - US\$640m – scientific satellite
- 5th Apr 2010
 - Galaxy 15 - **Loss of service for 9 months** - drifted around GEO – interference and risk of collision
- 7th March 2012,
 - Sky Terra 1 - Safe mode, **loss of service for a few days**
- Very difficult to say if Space Weather was the cause

BAS Radiation Belt Model

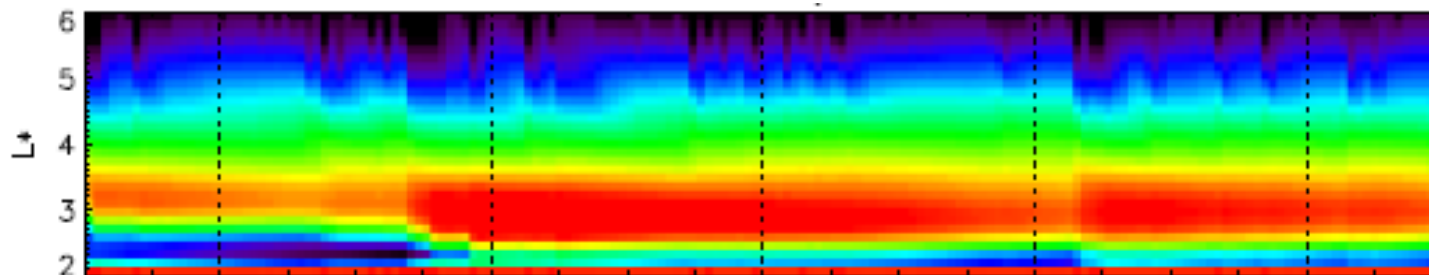
CRRES Relativistic Electrons



$J_{\perp} (\text{cm}^{-2}\text{s}^{-1}\text{sr}^{-1}\text{keV}^{-1})$

1000
100
10

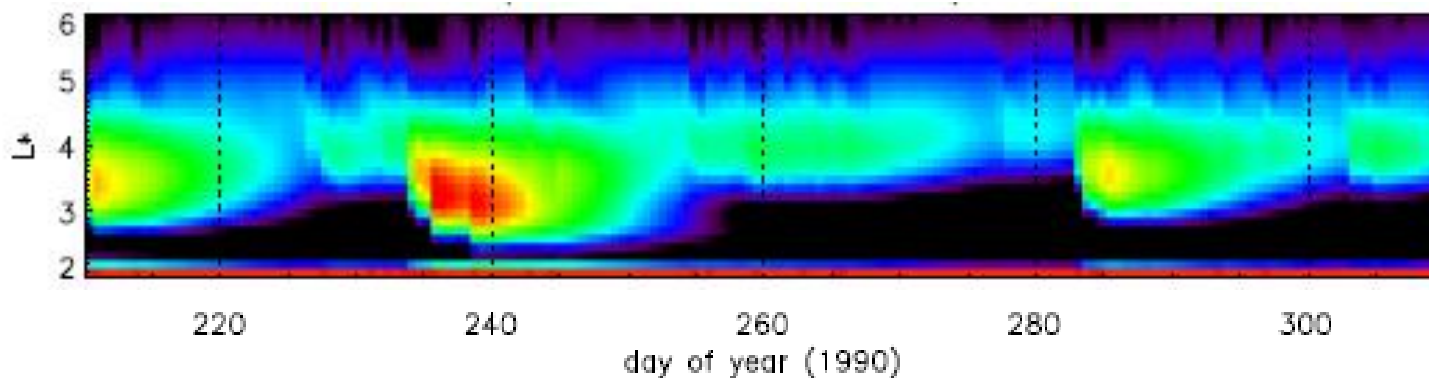
BAS Model with Radial Diffusion only



$J_{\perp} (\text{cm}^{-2}\text{s}^{-1}\text{sr}^{-1}\text{keV}^{-1})$

1000
100
10

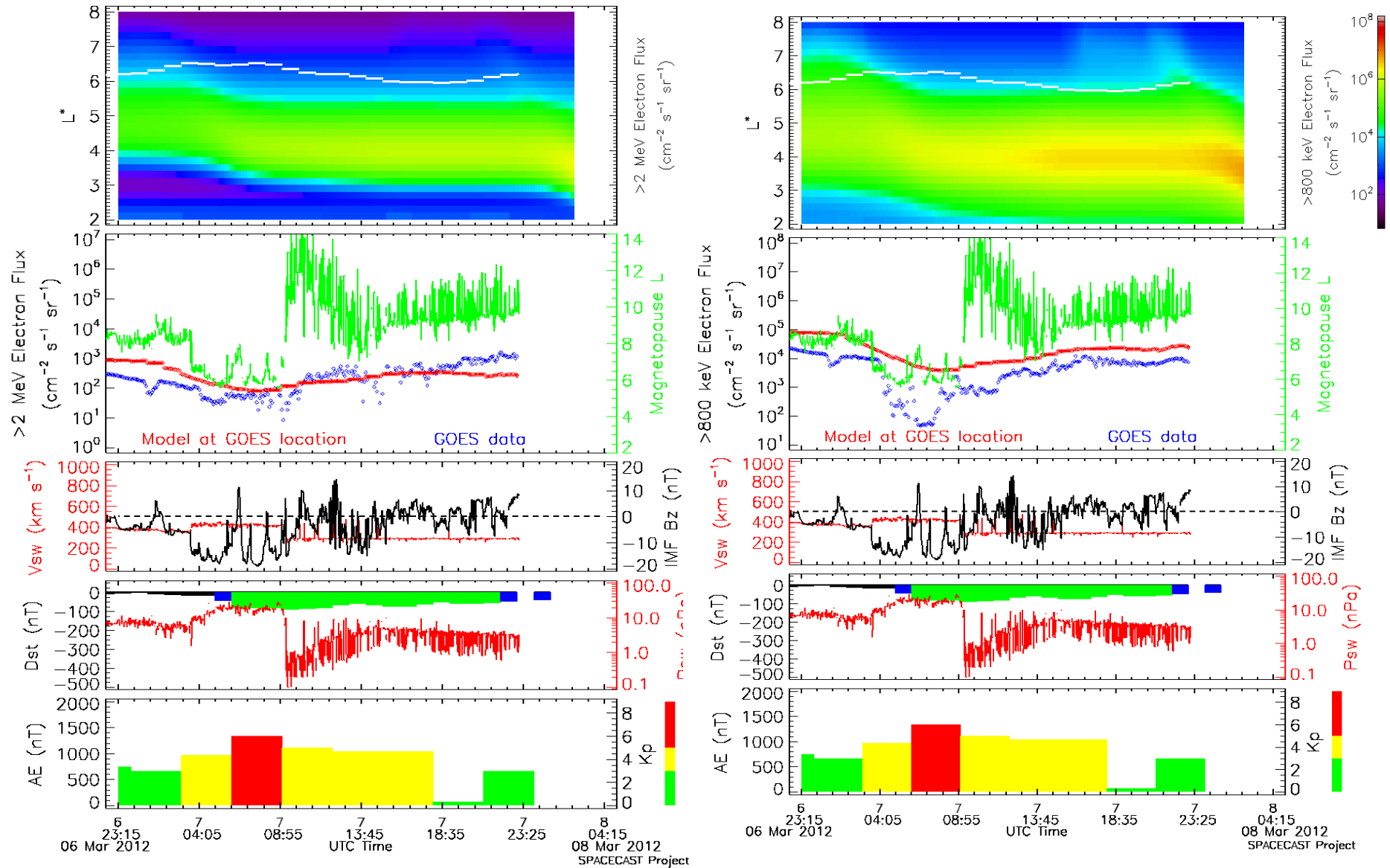
BAS Model with Radial Diffusion and Waves



$J_{\perp} (\text{cm}^{-2}\text{s}^{-1}\text{sr}^{-1}\text{keV}^{-1})$

1000
100
10

Magnetopause - Shue Model



Conclusions

- SPACECAST makes real time forecasts of the radiation belts for satellite operators
- Will issue warnings and alerts to stakeholders
- Models solar energetic particle events to help develop forecasts
- Pre-operational
- Scope to improve radiation belt forecasts via research
- Scope to link to atmosphere, ionosphere and solar wind to forecast other aspects of space weather



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